

LARVAL KEY TO GENERA AND SELECTED SPECIES OF NORTH AMERICAN COCCINELLIDAE (COLEOPTERA)

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Abstract.—An illustrated key to the larvae of 46 of the 60 genera of North American Coccinellidae is presented. The 14 genera not included are *Blaisdelliana* Gordon, *Bru-moides* Chapin, *Ceratomegilla* Crotch, *Decadiomus* Chapin, *Didion* Casey, *Exoplectra* Mulsant, *Gnathowisea* Gordon, *Helesius* Casey, *Hyperaspidius* Crotch, *Macronaemia* Casey, *Nipus* Casey, *Pseudoazyza* Gordon, *Selvadius* Casey, and *Zilus* Mulsant.

Key Words: Coccinellidae, North America, larvae, taxonomy, key

Progress in larval taxonomy has customarily lagged behind that of the adult stage throughout the holometabolous insects and the Coccinellidae are no exception. A means of identifying the prevalent larval stage is especially important because ladybeetles of several genera have become important to biological control programs. Previous keys by Böving (1917), Gage (1920), Storch (1970), and LeSage (1991) are not comprehensive enough to meet current needs for identification, even to genus, of North American ladybeetle larvae.

Larvae of Palaearctic ladybeetles have been much more extensively studied and can be identified to genus more readily than

their Nearctic counterparts. Principal publications on the Palaearctic fauna are those of van Emden (1949), Savoiskaya (1960, 1962, 1964a, 1964b, 1983), Kamiya (1965, 1966), Sasaji (1968a, 1968b), Klausnitzer (1970), Tao and Chiu (1971), Savoiskaya and Klausnitzer (1973), Sasaji and Tjubokawa (1983), and Majerus and Kearns (1989).

During his tenure (1940-1947) as a USDA curator, Bryant Rees prepared an illustrated manuscript key to larval genera and species of Coccinellidae deposited in the U.S. National Museum of Natural History collection. Years later, David Bouk incorporated additional North American genera and illustrations, and deleted some genera not represented in North America. Finally, Anderson and Gordon expanded the work to include all North American genera for which

¹ Deceased May 1985.

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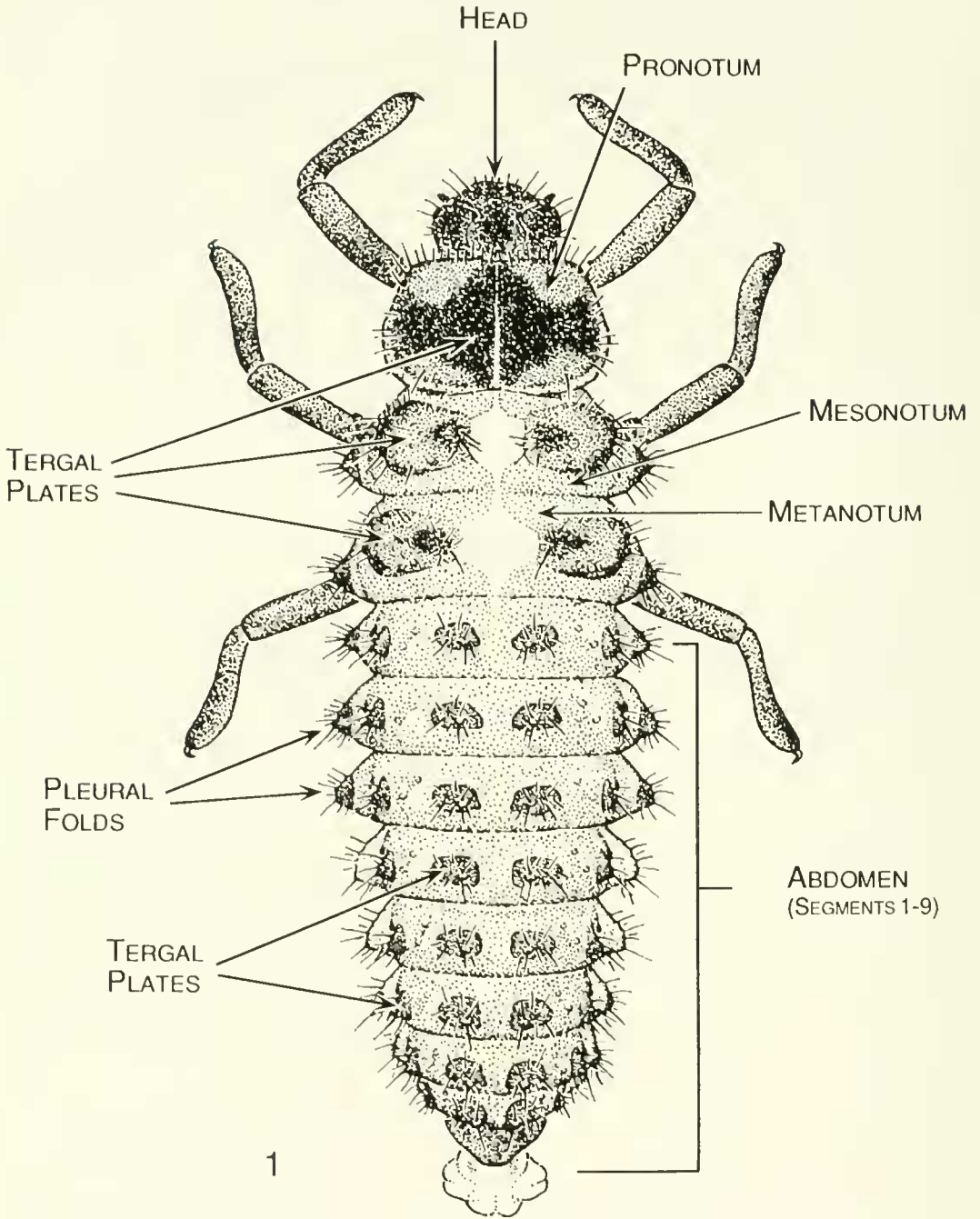
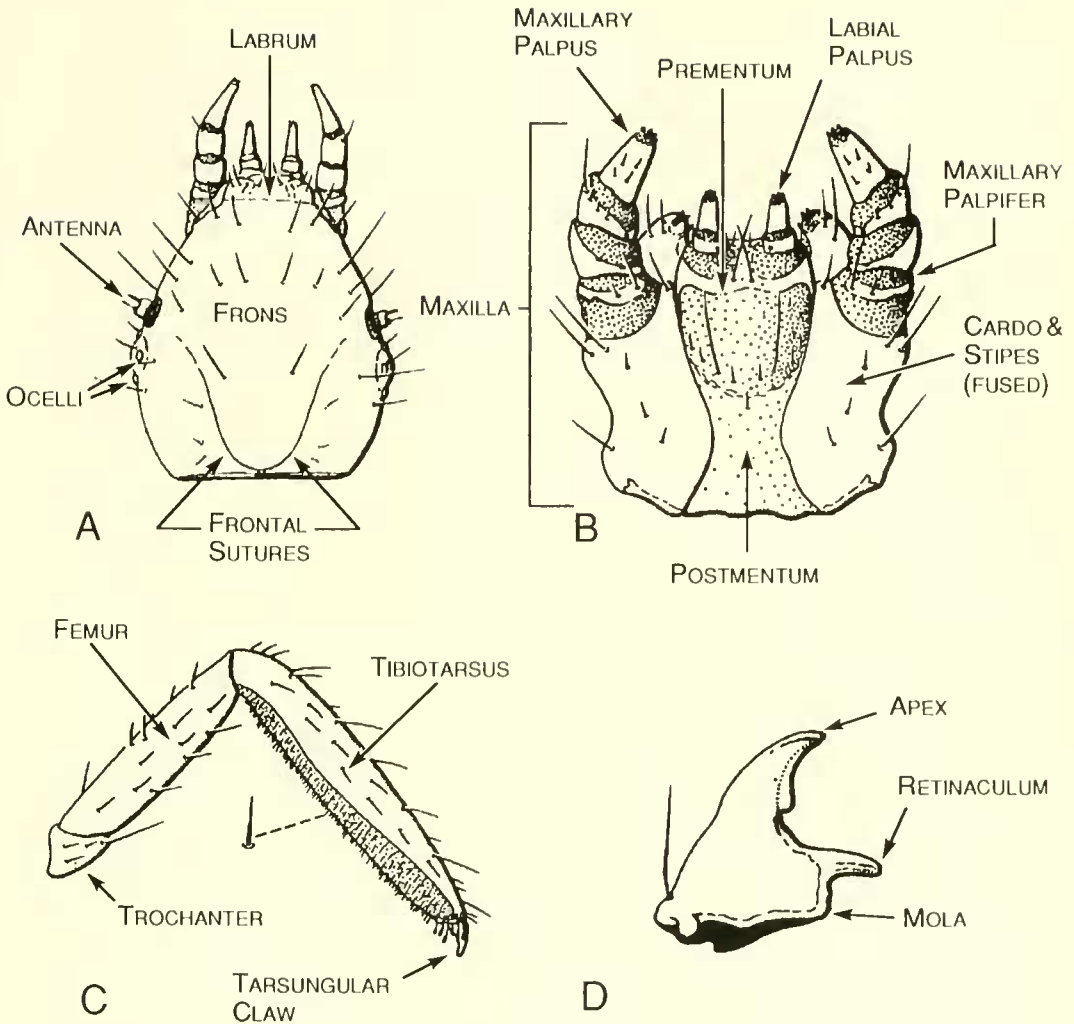


Fig. 1. Basic structures of larval Coccinellidae. *Neoharmonia venusta*, entire larva, dorsal view.



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Fig. 2. Basic structures of larval Coccinellidae. A. *Catana clauseni*, head, dorsal view. B-D, *Hippodamia convergens*: B. Labium and maxillae, ventral view. C. Leg, except for coxa, lateral view. D. Left mandible, dorsal view.

larval specimens were accessible, thus producing a publication that would complement the keys to genera of adults by Gordon (1985), Gordon and Vandenberg (1991), and pupae by Phuoc and Stehr (1974).

Forty-six of the 60 North American genera are included in this key. The 13 genera not included, because larval specimens are

not available, are: *Blaisdelliana* Gordon, *Brumoides* Chapin, *Ceratomegilla* Crotch, *Decadiomus* Chapin, *Didion* Casey, *Exoplectra* Mulsant, *Gnathoweisea* Gordon, *Helesius* Casey, *Hyperaspidius* Crotch, *Macronaemia* Casey, *Nipus* Casey, *Pseudozya* Gordon, *Selvadius* Casey, and *Zilus* Mulsant.

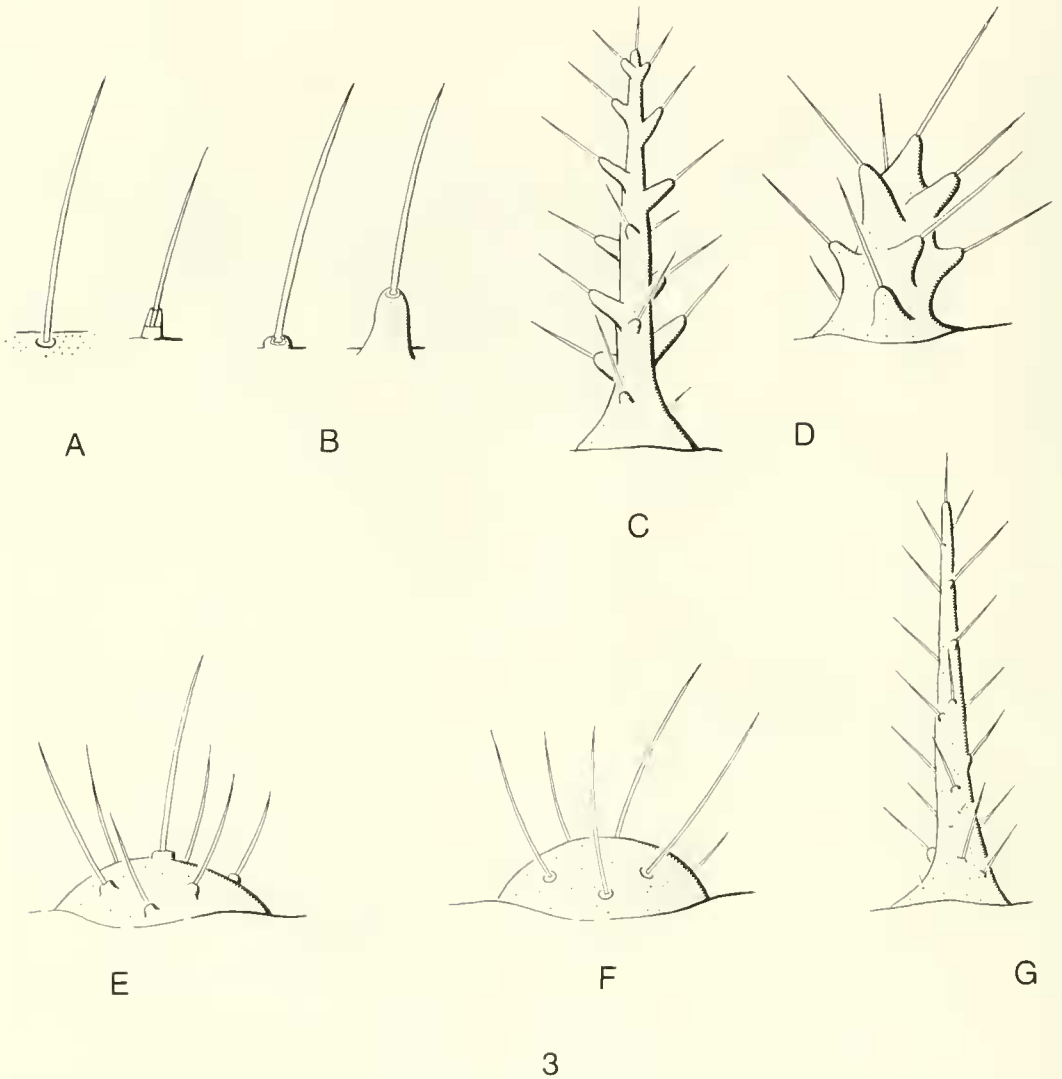


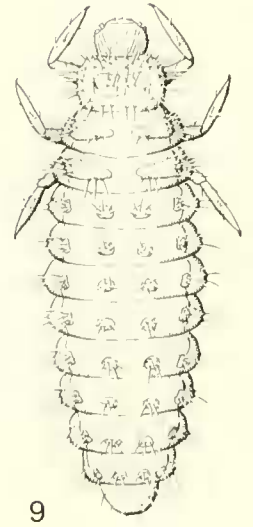
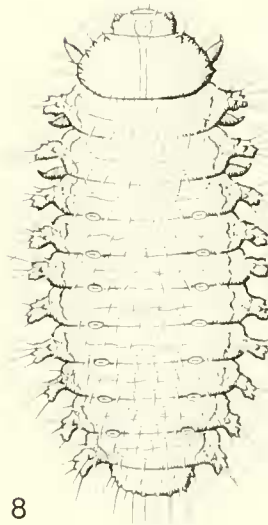
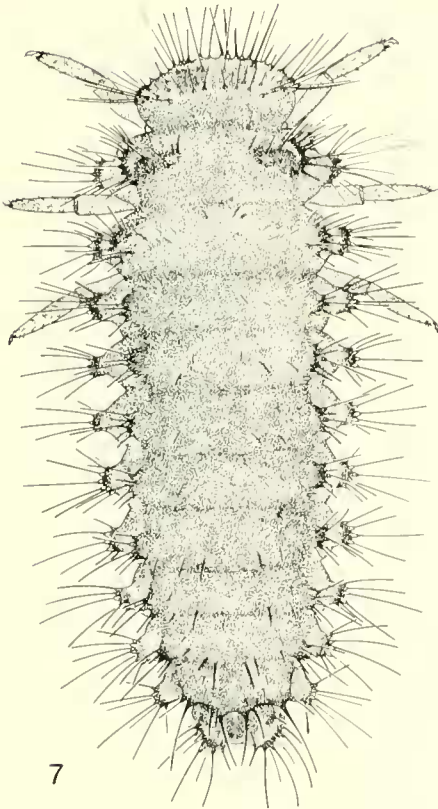
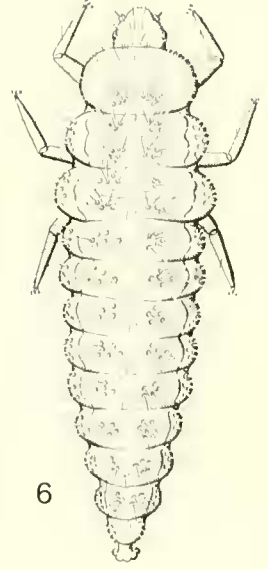
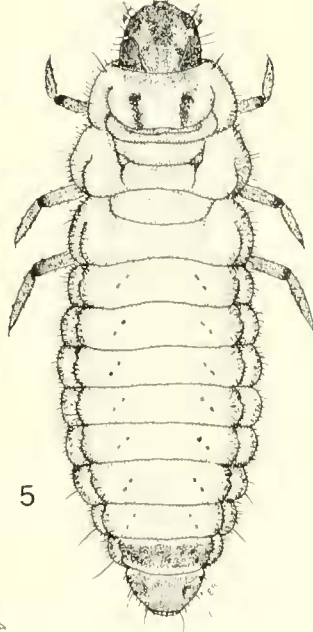
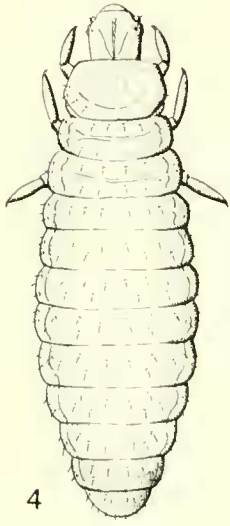
Fig. 3. Terminology of armature of larval Coccinellidae. A. Seta (left) and a collar seta (right). B. Chalazae. C. Scolus. D. Parascolus. E. Struma. F. Verruca. G. Sentus.

The illustrations contained herein were done by several different illustrators over a period of years, hence they are not uniform but rather reflect the style of each artist. In several instances structures shown were drawn from taxa not represented in North America. Because cost is a major factor in producing a publication needing many illustrations, available illustrations were utilized wherever possible as long as they accurately reflected the character(s) in question. Genera mentioned in the key but

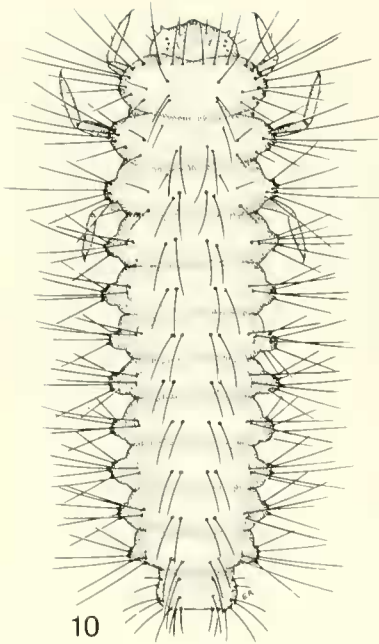
not occurring in North America are *Catana*, *Halysia*, *Ortalistes*, *Synonycha*, and *Tytthaspis*. In many cases figures of taxa appearing previously in the key are repeated because they best illustrate a pertinent character.

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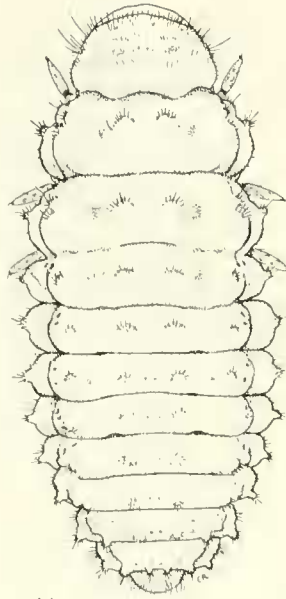
Ladybeetle larvae possess armature of the body wall in the form of variously shaped setose projections. Each type of projection has a name, therefore this terminology must



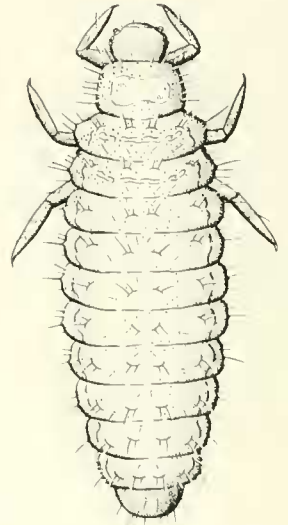
Figs. 4-9. Habitus views. Fig. 4, *Microweisea misella*; 5, *Coccidophilus* sp.; 6, *Delphastus pusillus*; 7, *Zagloba* sp.; 8, *Cephaloscymnus* sp.; 9, *Stethorus* sp.



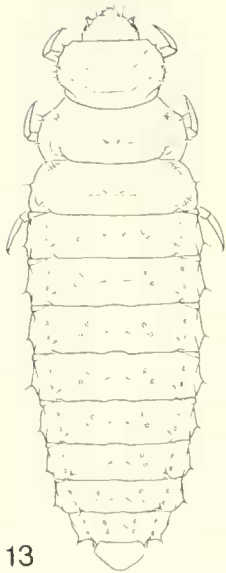
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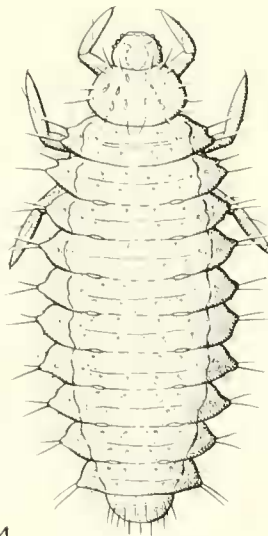
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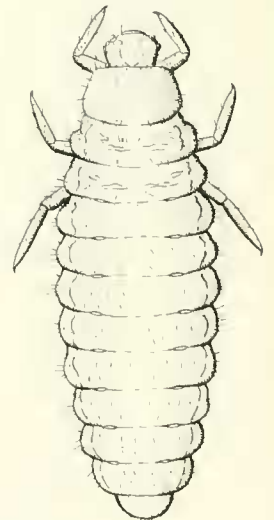
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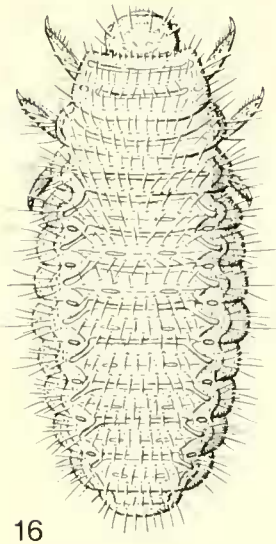


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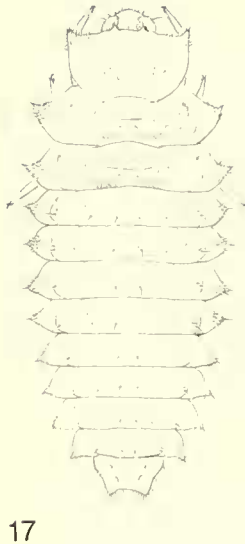


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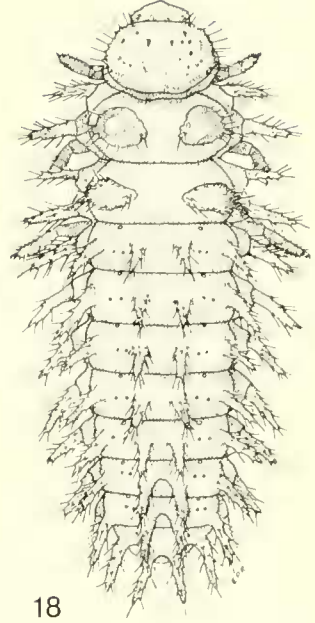
Figs. 10-15. Habitus views. Fig. 10, *Nephaspis oculata*; 11, *Cryptolaemus montrouzieri*; 12, *Scymnus (Pullus)* sp.; 13, *Nephus* sp.; 14, *Diomus roseicollis*; 15, *Decadiomus pictus*.



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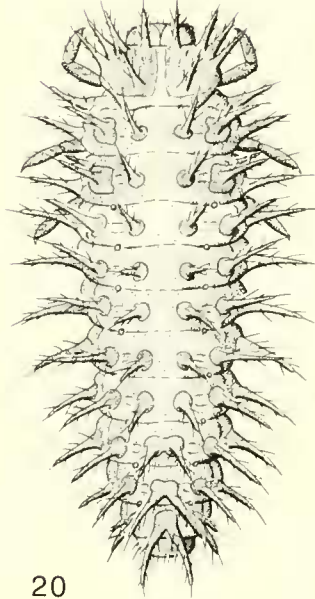
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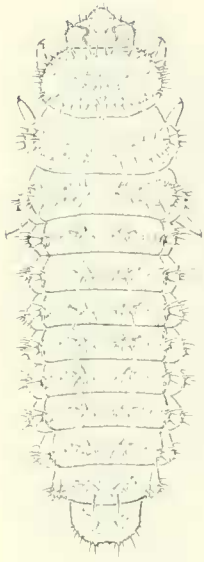


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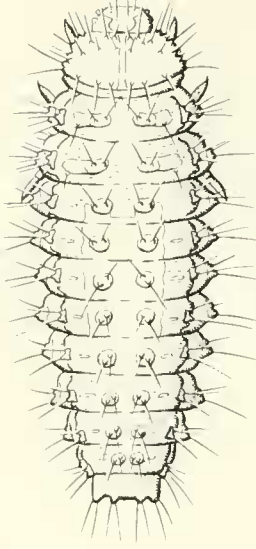


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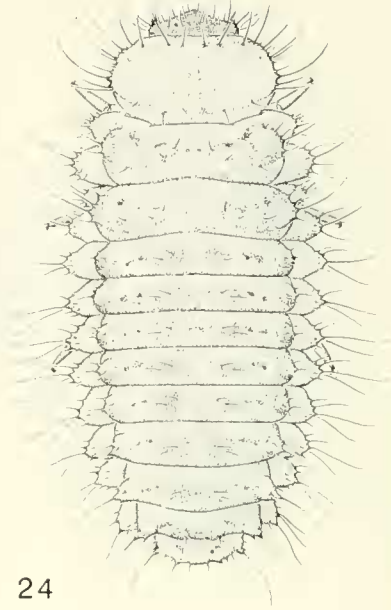
Figs. 16–21. Habitus views. Fig. 16, *Hyperaspis signata*; 17, *Cryptognatha nodiceps*; 18, *Arawana scapularis*; 19, *Exochomus marginipennis*; 20, *Chilocorus stigma*; 21, *Ortalistes rubidus*.



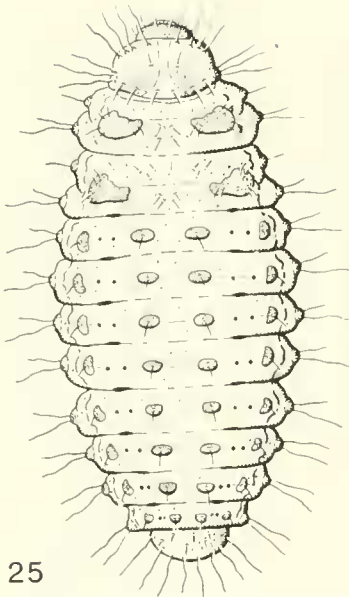
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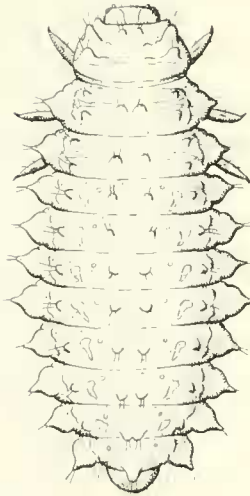
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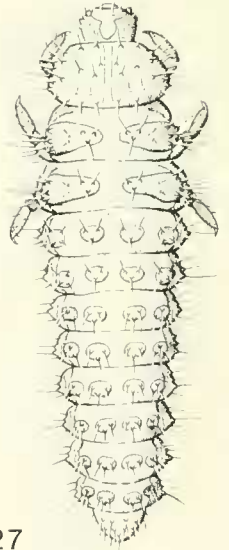
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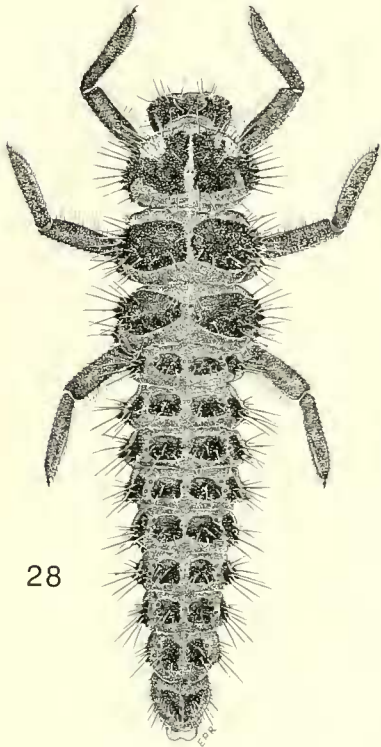


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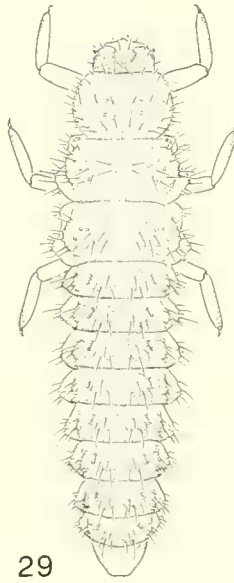


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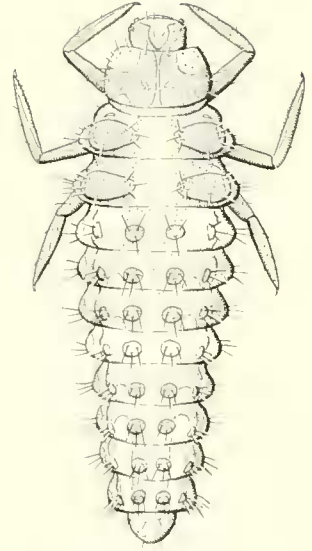
Figs. 22-27. Habitus views. Fig. 22, *Coccidula rufa*; 23, *Rhyzobius lophanthae*; 24, *Rhyzobius forestieri*; 25, *Rodolia cardinalis*; 26, *Azya* sp.; 27, *Anisosticta* sp.



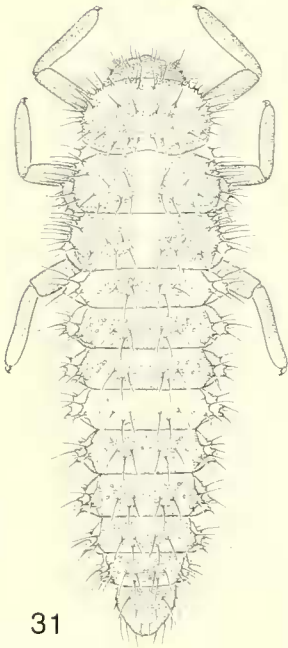
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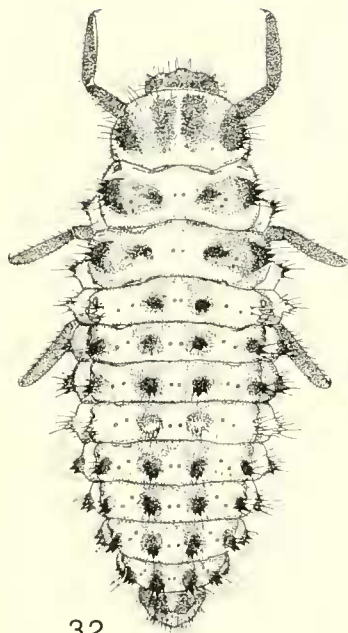
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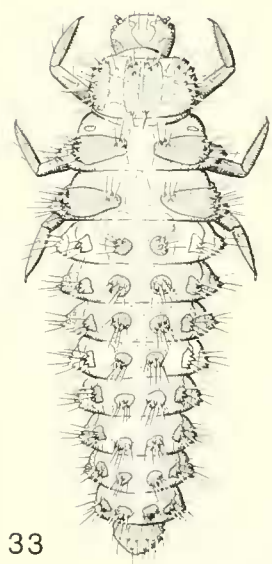
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Figs. 28–33. Habitus views. Fig. 28, *Paranaemia vittigera*; 29, *Naemia seriata*; 30, *Coleomegilla maculata*; 31, *Coleomegilla maculata fuscilabris*; 32, *Hippodamia undecimnotata*; 33, *Hippodamia convergens*.

be understood before keys or descriptions can be utilized. The following glossary of terms has been modified from Gage (1920).

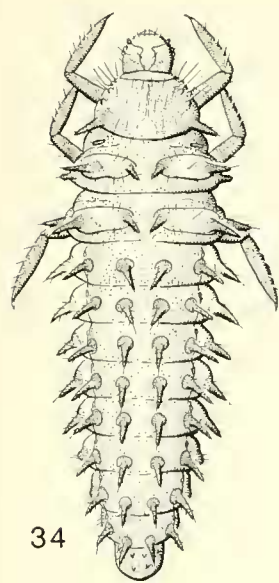
- collar seta Seta, surrounded by a raised collar at the base (Fig. 3A, right).
- chalaza Projection of the body wall bearing a seta (Fig. 3B).
- scolus Branched projection usually more than 5 times as long as wide, each branch with a single terminal seta (Fig. 3C).
- parascolus Shortened, modified scolus covered by chalazae (Fig. 3D).
- struma Mound-like projection bearing chalazae (Fig. 3E).
- verruca Low, rounded elevation (reduced struma) bearing setae instead of chalazae (Fig. 3F).
- sentus Long, cone-like, unbranched projection with several setae (Fig. 3G).

Illustrations of various structures are labeled above to facilitate use of the key to larvae.

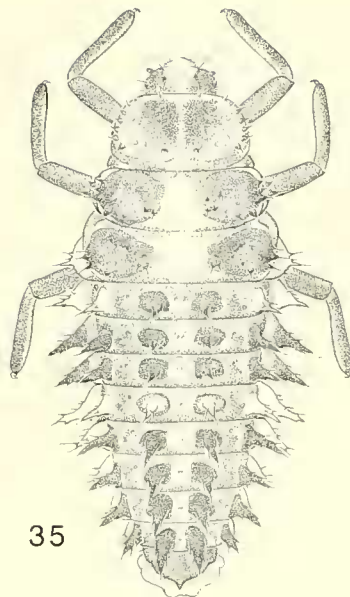
KEY TO LARVAE

- 1. Mandible with digitiform teeth, retinaculum absent (Fig. 76); terga with scoli (Figs. 3C, 48, 127, 128), sometimes with parascoli (Fig. 3D); frontoclypeal suture complete (Fig. 52); antenna long, 3 or more times as long as wide, of nearly uniform diameter (Fig. 88) Epilachninae ... 2
- Mandible other than with digitiform teeth, apically simple (Figs. 65, 67, 68) or with 2 to 5 teeth (Figs. 73, 74, 77, 79), with retinaculum (Figs. 66, 68, 74, 79) or without retinaculum (Figs. 63, 67); terga with structures other than scoli, parascoli sometimes present; frontoclypeal suture incomplete or absent (Fig. 2A); antenna usually short (Figs. 83, 85, 90), less than 3 times as long as wide, if long (Fig. 91), segments distinctly of different diameters (Fig. 84) 3
- 2(1). Setae of scoli nearly as short or shorter than bases supporting them (Fig. 127);

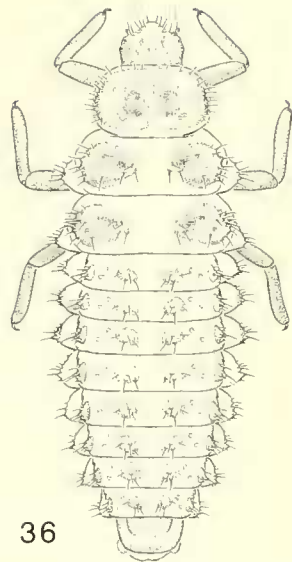
- habitus Fig. 48 *Epilachna* Dejean
- Setae of scoli several times longer than bases supporting them (Fig. 128); habitus Fig. 49 *Subcoccinella* Guerin
- 3(1). Abdominal terga 1-8 each distinctly divided transversely into 2 parts (Fig. 16) with setae or collar setae (Fig. 3A); head broader than long (Fig. 53); labial palpus 1-segmented, palpiger indistinct or absent (Fig. 58) mandible simple, with retinaculum (Fig. 68) ... Hyperaspidini ... 4
- Abdominal terga entire, not distinctly divided transversely (Fig. 15) or only weakly so (Fig. 14); head usually not broader than long; tergal structures variable; labial palpus 2-segmented, with or without palpiger (Figs. 60, 61, 62); mandible, head variable 6
- 4(3). Terminal segment of maxillary palpus slender, 3 times or more as long as its basal width, as long as segments 1, 2 combined; maxillary, labial palpi elongate, with maxillary palpifer, labial palpiger weakly sclerotized; tergal segmental pores circular to oval, large (Fig. 100) *Brachiacantha* Chevrolat
- Terminal segment of maxillary palpus not as long as segments 1-2 combined; labial palpus short, seniglobular, palpiger absent (Fig. 58); tergal segmental pores elliptical, slitlike, small (Fig. 16) 5
- 5(4). Submentum sclerotized, pigmented, fused with cardines of maxillae to form sclerotized, transverse, pigmented U-shaped basal bridge (Fig. 59); pronotum without pigmented areas *Thalassa montezumae* Mulsant
- Submental area usually weakly sclerotized or with faint sclerites, cardines of maxilla not fused with submental sclerite or transversely connected to each other; if submental area strongly sclerotized, then pronotum with pigmented areas as in Figs. 93, 94, sternum of 9th abdominal segment with pigmented sclerites; habitus Fig. 16 *Hyperaspis* Dejean
- 6(3). Abdomen dorsolaterally with longitudinal series of 8 prominent, circular (occasionally slightly elongate) intersegmental pores, pores strongly sclerotized, usually darkly pigmented (Fig. 20); body with senti 6-8 times as long as wide at base (Fig. 3G), or with parascoli (Fig. 3D) Chilocorini ... 7
- Abdomen without dorsolateral series of circular, strongly sclerotized pores; when intersegmental pores present, elliptical to subcircular, weakly sclerotized (Figs. 8,



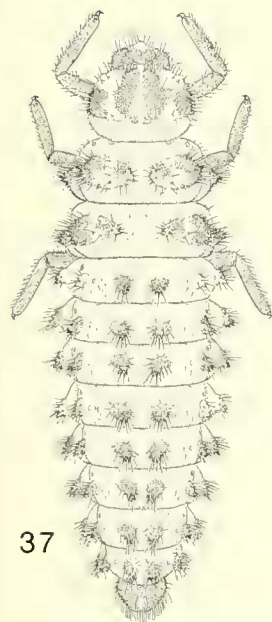
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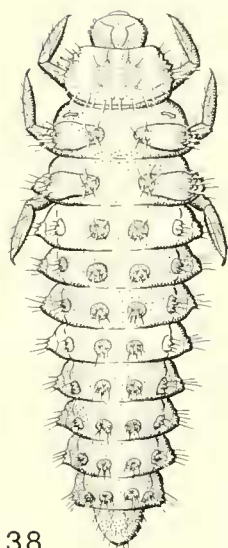
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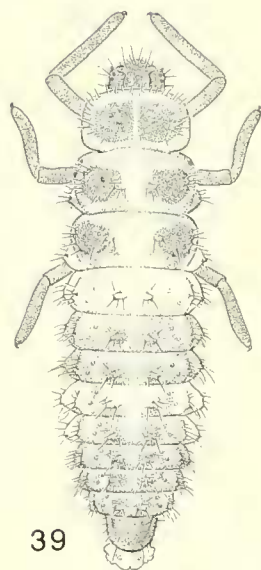
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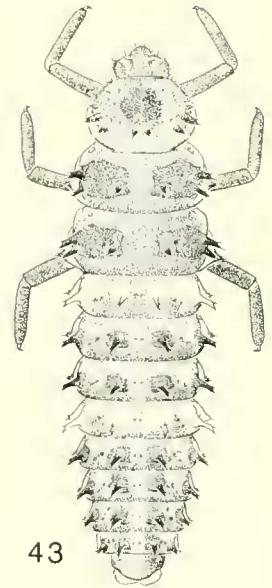
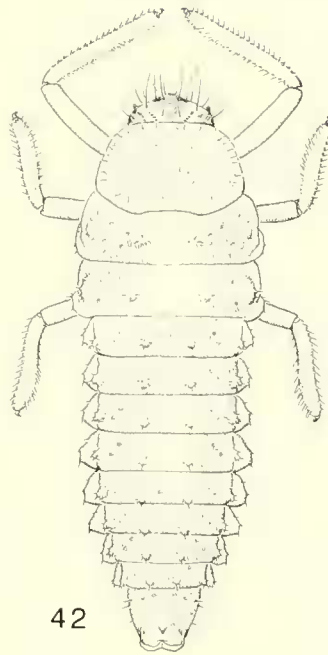
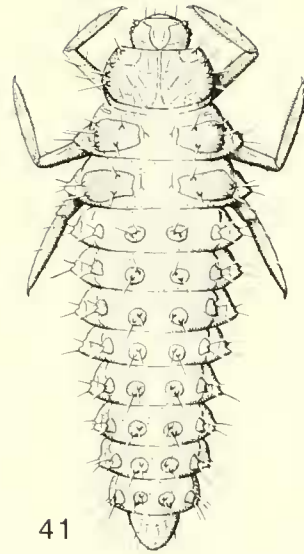
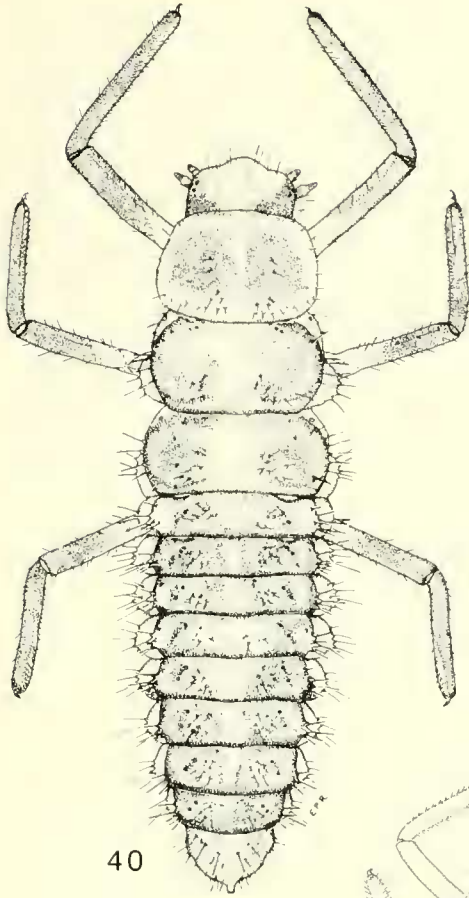
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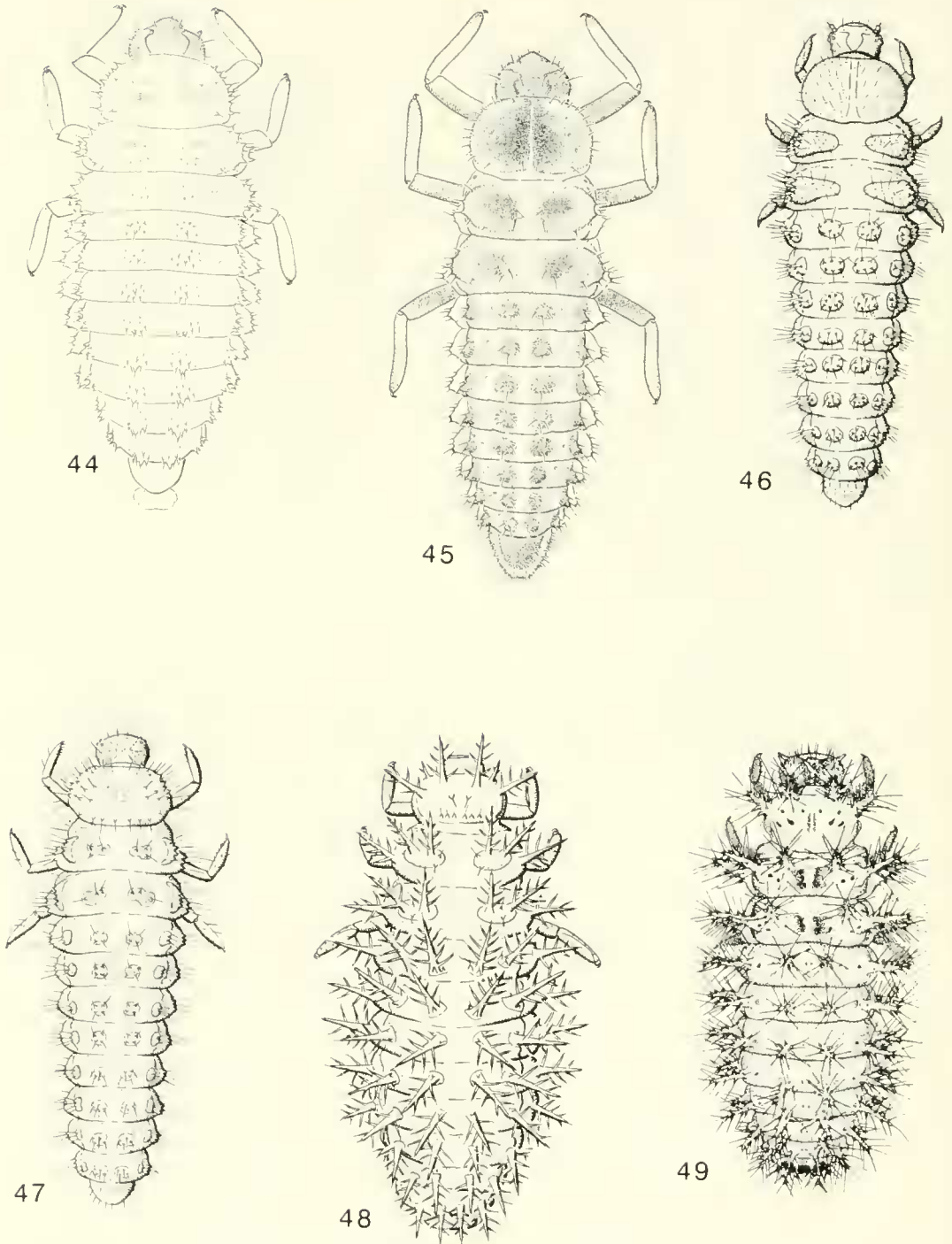
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Figs. 34–39. Habitus views. Fig. 34, *Anatis* sp.; 35, *Calvia quatuordecimguttata*; 36, *Adalia bipunctata*; 37, *Coccinella septempunctata*; 38, *Coccinella novemnotata*; 39, *Cycloneda* sp.

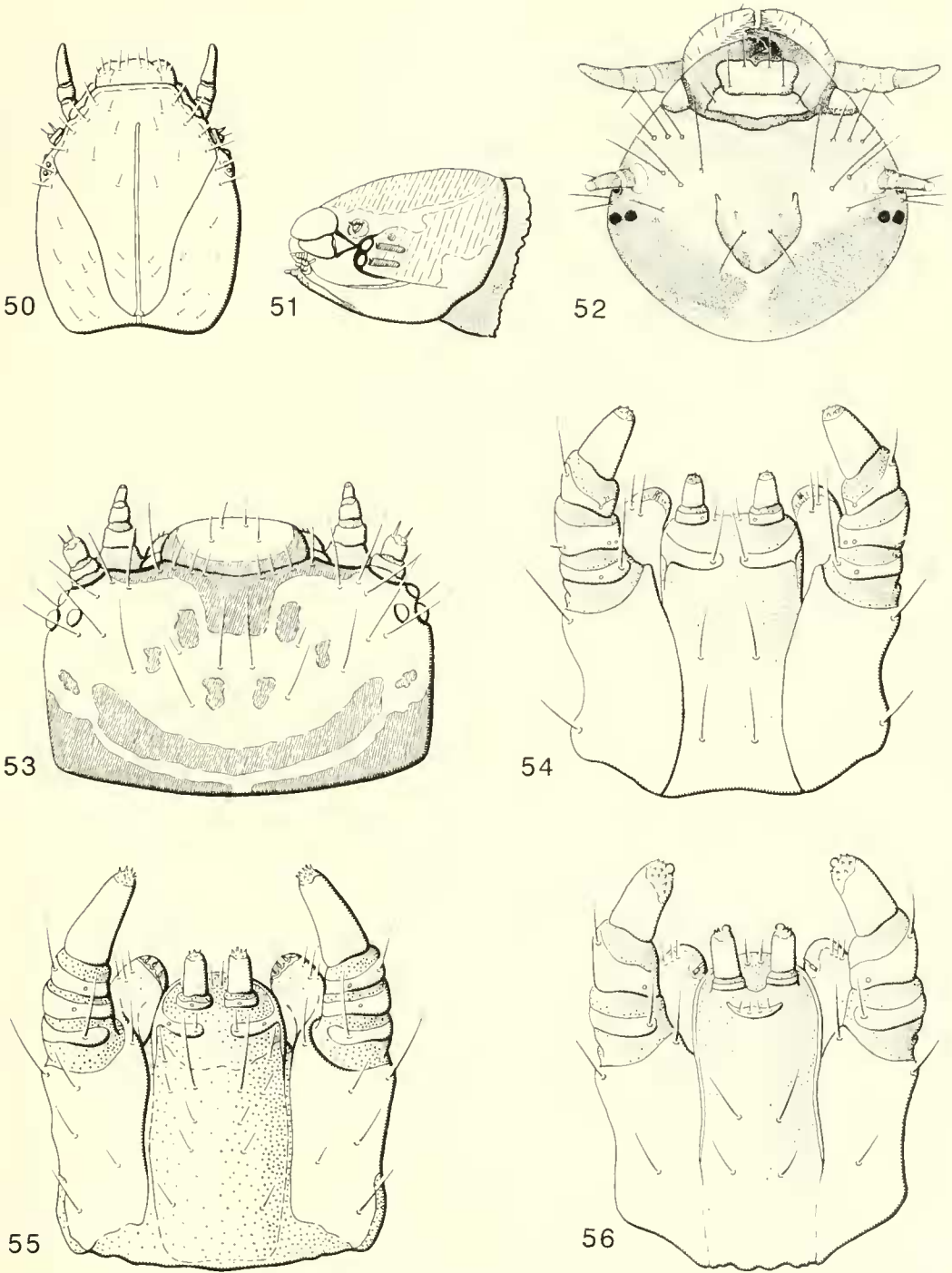
14, 16, 102, 103); senti and or parascoli variable	14	15(14). Tergal strumae with apically shredded, truncated setae of various lengths, along with normally pointed setae; pleural folds with strumae bearing several prominent setae; asperities distinct, acute; mandible apically simple, with 2 longitudinal rows of small serrations on mesal surface; habitus Fig. 7	
7(6). Apex of mandible simple; coronal (epicranial) suture absent	8	..... Scymnillini ... <i>Zagloba</i> Casey	
- Apex of mandible bidentate (Fig. 73); coronal (epicranial) suture present	13	- Tergal strumae small, with normal, pointed setae; pleural folds pointed, each bearing single prominent seta, several short setae (Fig. 17); asperities absent on abdominal terga but present on pleural folds; mandible apically simple, with 2 rows of very small serrations on mesal surface; habitus Fig. 17	
8(7). Pronotal and mesonotal tergites laterally with 3 senti, often with an additional short sentus at anterolateral angle (Fig. 96); metathoracic tergites each with 1 lateral sentus, if 2 present, then 2nd slender, short (Fig. 96)	<i>Axiom</i> Mulsant	..... Cryptognathini (only one species in North America— <i>C. nodiceps</i> Marshall)	
- Thoracic tergites not as described above	9	..... <i>Cryptognatha</i>	
9(8). Abdominal tergites 1–8 with senti or parascoli	10	16(14). Mandible with 5 distinct, serially arranged teeth, retinaculum dentate (Figs. 78, 79); abdominal terga 1–8 with strumae (Fig. 3E); habitus Fig. 47	
- Abdominal tergites 1–8 with senti only, at least dorsolaterally, laterally (Fig. 20)	11	..... Psylloborini ... <i>Psyllobora</i> Dejean	
10(9). Abdominal tergites 1–8 with dorsal, dorsolateral parascoli basally, gradually lengthening into senti terminating in single chalaza posteriorly		- Mandible otherwise; tergal structures variable	17
..... <i>Exochomus quadripustulatus</i> (L.)		17(16). Mandible without retinaculum, apically simple (Figs. 63–65, 67)	
- Abdominal terga 1–8 dorsally, dorsolaterally with parascoli lengthening posteriorly and terminating in 2 or 3 unequal chalazae, as in Fig. 122		..... Sticholotidinae ...	18
..... <i>Brumoides suturalis</i> (F.)		- Mandible with retinaculum, apically simple or otherwise (Figs. 68, 69, 73, 74)	21
11(9). Meso-, metathoracic tergites each with single long sentus on lateral margin (Fig. 95); habitus Fig. 18	<i>Arawana</i> Leng	18(17). Mandible elongate, slender, with medial, lateral serrations, molar area not developed (Fig. 67); body broadly elliptical; abdomen on each side with longitudinal row of elliptical intersegmental pores (Fig. 8), abdominal pleura with protuberant strumae (Figs. 8, 104); habitus Fig. 8	
- Meso-, metathoracic tergites otherwise	12	..... <i>Cephaloscymnus</i> Crotch	
12(11). Mesothoracic tergites each with 3 short, unequal, lateral senti; metathoracic tergites each with 2 (sometimes 3) short, unequal, lateral senti; chalazae of both tergites with short, subconical bases (Fig. 19, habitus)		- Mandible triangular, apically curved, with molar area developed (Figs. 63–65); abdomen without intersegmental pores	19
..... <i>Exochomus marginipennis</i> (LeConte) and <i>E. childreni childreni</i> Mulsant		19(18). Frontal sutures distinct, terga with short, inconspicuous setae (Figs. 4, 5)	20
- Meso-, metathoracic tergites each with a rudimentary posterolateral sentus and chalazae; bases of chalazae small, broadly rounded	<i>Exochomus californicus</i> Casey	- Frontal sutures incomplete, indistinct to obsolete; principle body setae long, each seta rising from small, circular, pigmented spot; habitus Fig. 6	
13(7). Pronotum with 6 or more senti on each side (Fig. 97); meso-, metathoracic terga with 2 distinct, complete tergites, each bearing 2 senti		..... <i>Delphastus</i> Casey	
..... <i>Halmus chalybeus</i> Boisduval		20(19). Head with dark, median, longitudinal line or elevation on frons (Fig. 50); pronotum with 2 faintly pigmented patches; habitus Fig. 4	
- Pronotum with 5 or fewer senti (Fig. 3G); meso-, metathorax without complete tergites, tergites reduced to areas at base of senti; meso-, metathoracic terga each with 4 senti, 2 mesally, 1 on each lateral area; habitus Fig. 20	<i>Chilocorus</i> Leach	..... <i>Microwisea</i> Cockerell	
14(6). Antenna salient, 2nd segment nearly as long or as long as 1st but of ½ or less diameter as in <i>Pentilia</i> (Fig. 84)	15	- Entire cranium darkly pigmented; pronotum with 2 prominent, longitudinal pigmented patches; habitus Fig. 5	
- Antenna otherwise (Figs. 83, 85, 88)	16	..... <i>Coccidophilus</i> Brethes	



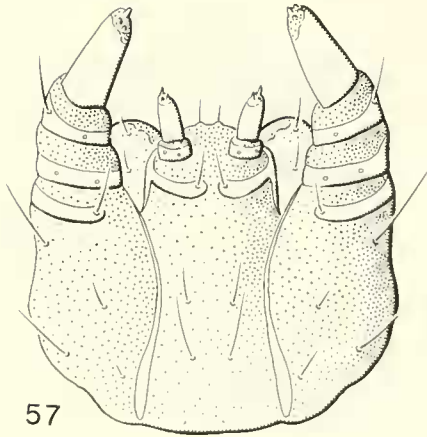
Figs. 40–43. Habitus views. Fig. 40, *Propylea quatuordecimpunctata*; 41, *Olla v-nigrum*; 42, *Coelophora inaequalis*; 43, *Harmonia conformis*.



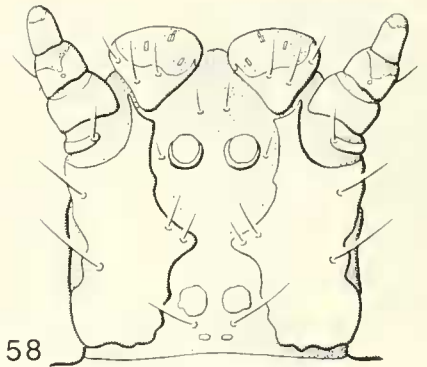
Figs. 44-49. Habitus views. Fig. 44, *Aphidecta obliterata*; 45, *Mulsantina* sp.; 46, *Tythaspis sedecimpunctatus*; 47, *Psyllobora vigintimaculata*; 48, *Epilachna varivestis*; 49, *Subcoccinella vigintiquatuor punctata*.



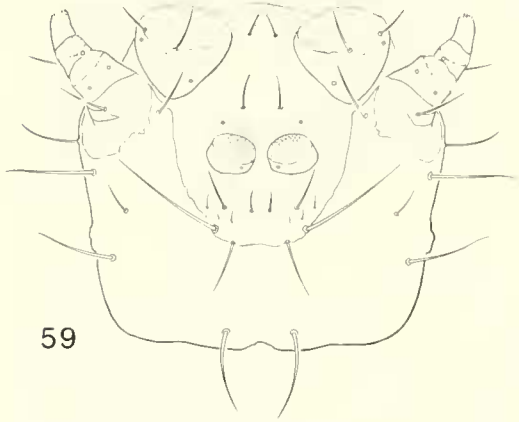
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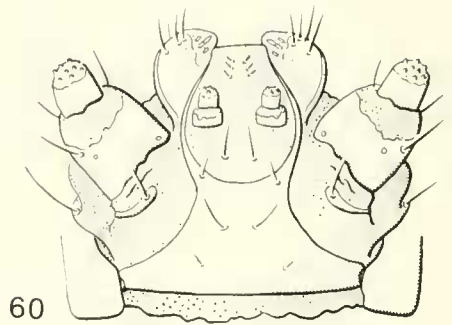
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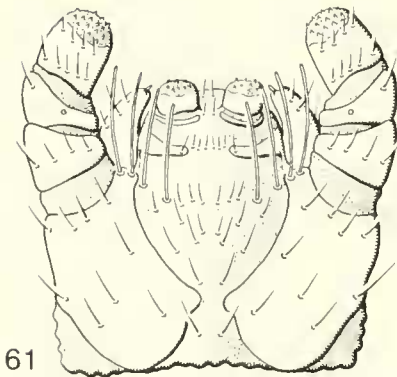
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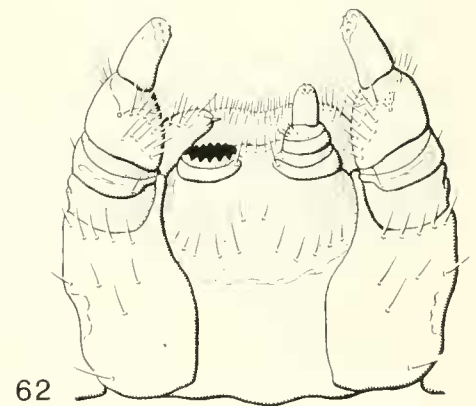
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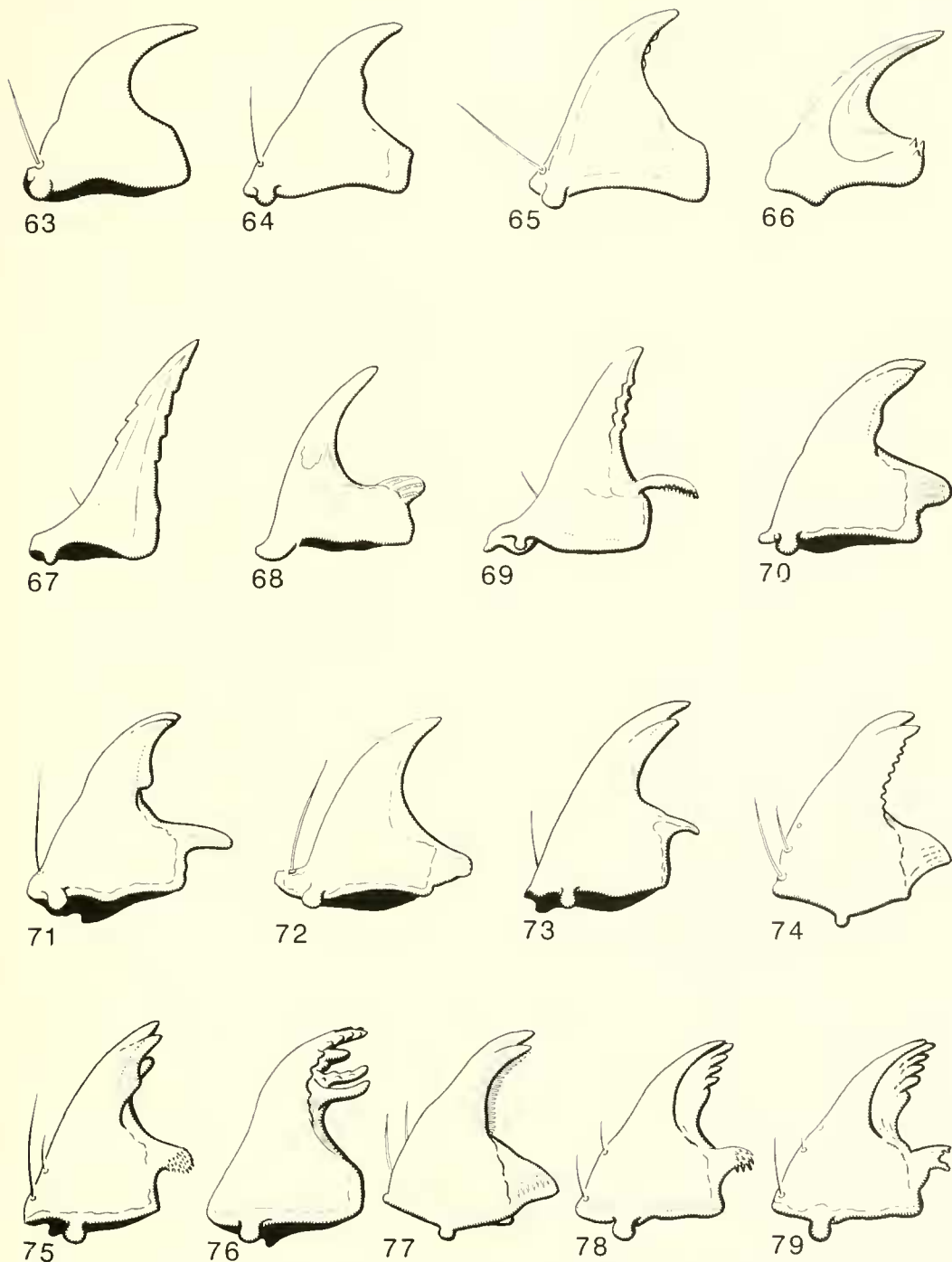


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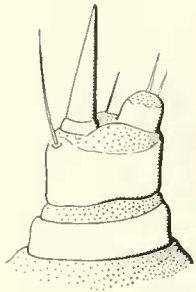


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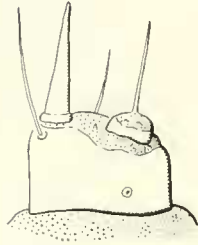
Figs. 57-62. Ventral mouthparts. Fig. 57, *Stethorus punctum*; 58, *Hyperaspis signata*; 59, *Thalassa montezumae*; 60, *Rodolia cardinalis*; 61, *Psyllobora vigintimaculata*; 62, *Tytthaspis sedecimpunctata*.



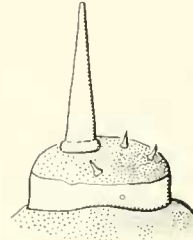
Figs. 63-79. Mandibles, ventral view, right mandible. Fig. 63, *Microwiseia ovalis*; 64, *Delphastus pusillus*; 65, *Catana clauseni*; 66, *Ortalistes rubidus*; 67, *Cephaloscymmus* sp.; 68, *Hyperaspis signata*; 69, *Pentilia castanea*; 70, *Cryptolaemus montrouzieri*; 71, *Rhyzobius lophanthae*; 72, *Azya* sp.; 73, *Chilocorus stigma*; 74, *Anisosticta bitrangularis*; 75, *Synonycha grandis*; 76, *Epilachna borealis*; 77, *Tythaspis sedecimpunctata*; 78, *Halyzia sedecimguttata*; 79, *Psyllobora vigintimaculata*.



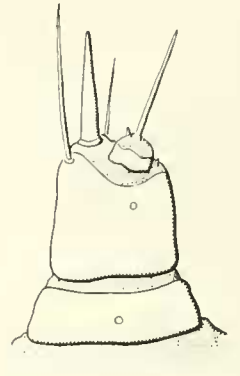
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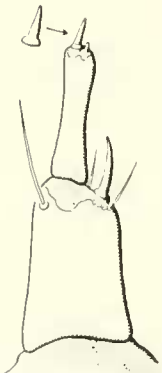
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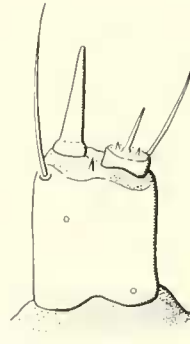
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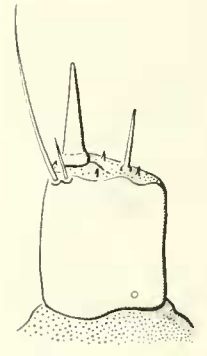
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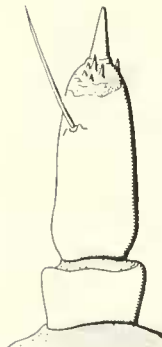
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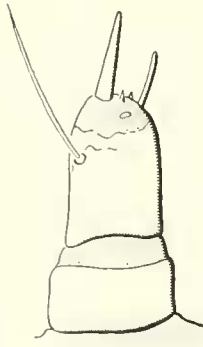
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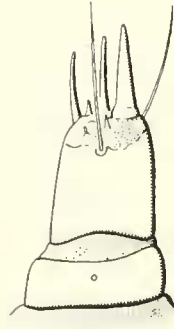
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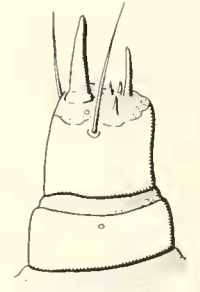
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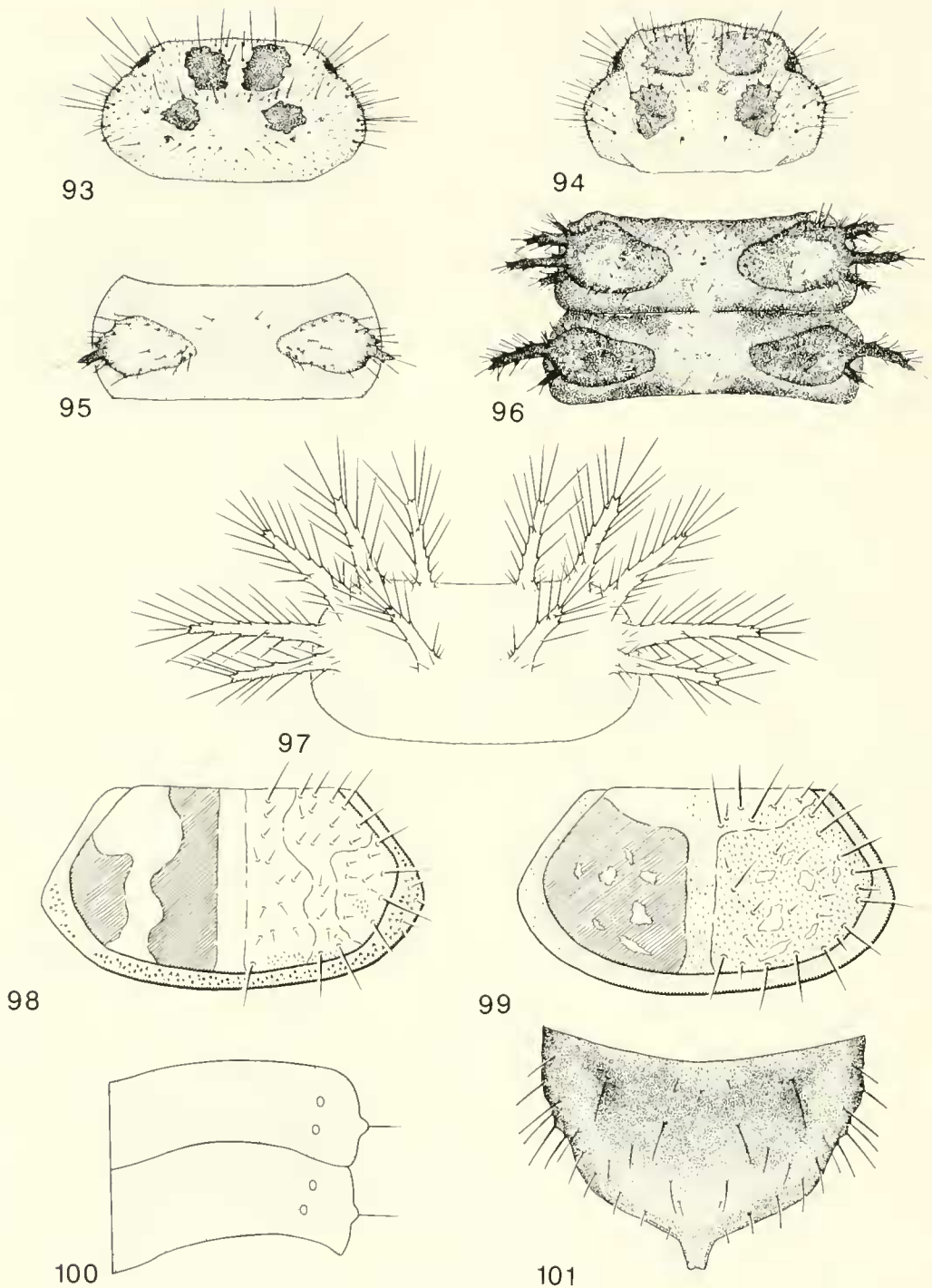
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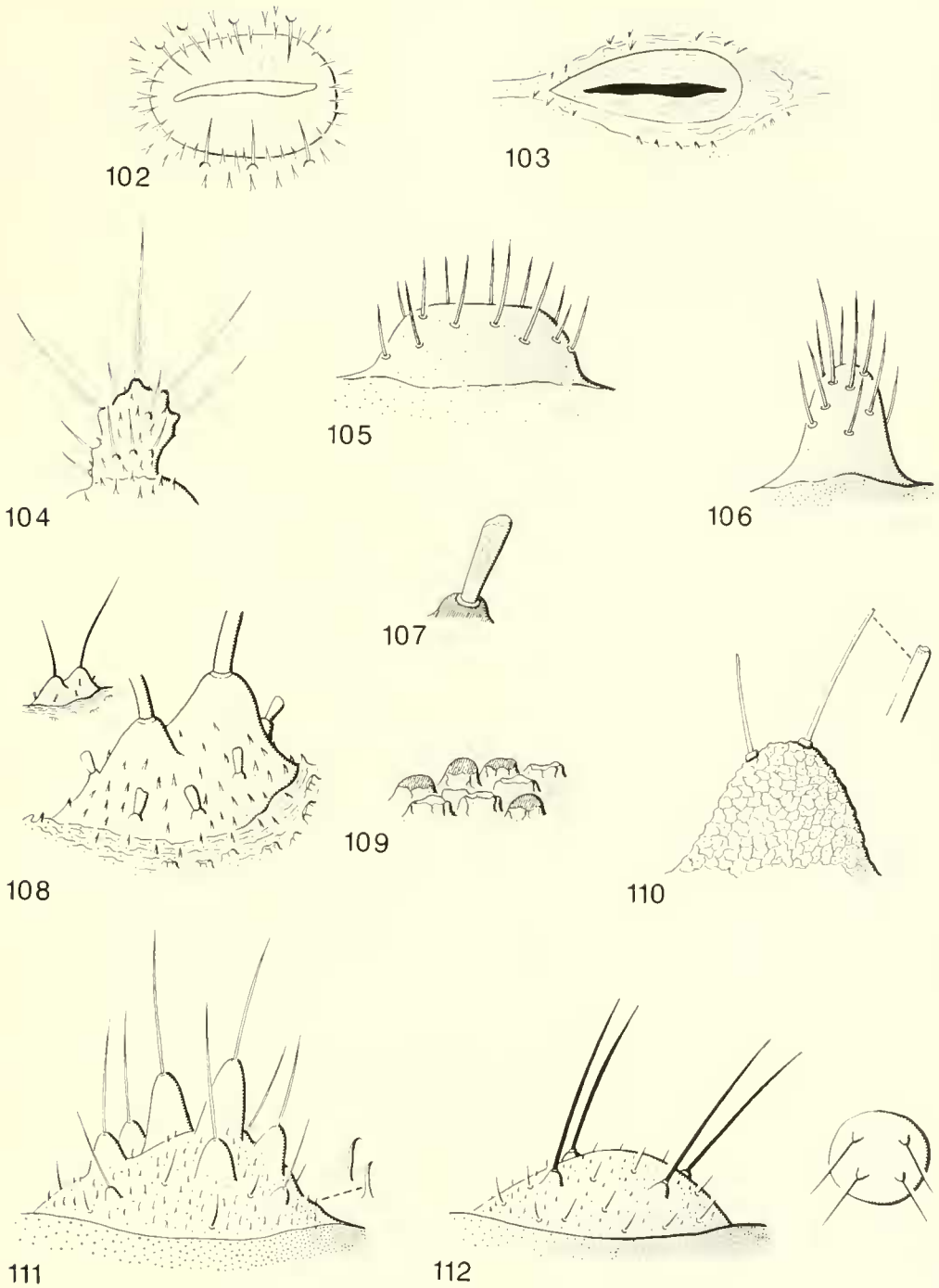
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Figs. 80-92. Antennae. Fig. 80, *Scymnus (Pullus)* sp.; 81, *Nephus (Scymnobioides)* sp.; 82, *Stethorus punctum picipes*; 83, *Hyperaspis signata*; 84, *Pentilia castanea*; 85, *Chilocorus stigma*; 86, *Rodolia cardinalis*; 87, *Anovia virginalis*; 88, *Epilachna varivestis*; 89, *Tythaspis sedecimpunctata*; 90, *Psyllobora vigintimaculata*; 91, *Ortalhistes rubidus*; 92, *Anisosticta bitriangularis*.

21(17).	Mandible apically bidentate (Figs. 70, 71, 73), or apically bidentate with sub-apical tooth (Fig. 75), serrations (Fig. 74), or structures resembling teeth of comb (Fig. 77)	22	-	Dorsal senti of abdominal terga long on terga 4-8, progressively longer on terga 1-7 (Fig. 35) <i>Calvia quatuordecimguttata</i> (L.)	
-	Mandible apically simple (Figs. 66, 68), serrations present or absent	43	28(26).	Abdominal terga bearing stout setae (Fig. 3G); habitus Fig. 34 <i>Anatis</i> Mulsant	
22(21).	Frontal sutures distinct (Figs. 27, 34, 46); meso-, metathoracic tergites each with 2 sclerites (Figs. 30, 33, 34), sometimes weak (Fig. 23), or with structures other than setae	23	-	Abdominal terga armed with apically bifurcate or trifurcate parascoli (Fig. 122); habitus Fig. 43 <i>Harmonia conformis</i> Mulsant	
-	Frontal sutures indistinct, evident posteriorly (Fig. 2A); meso-, metathoracic terga with prominent verrucae instead of sclerites (Figs. 11, 105, 106); abdominal terga 1-8 with similar verrucae; habitus Fig. 11		29(25).	Mandible apically bidentate with additional subapical tooth, serrations (Fig. 74); body terga with strumae; antenna 2-segmented (Figs. 89, 92); habitus Fig. 27 <i>Anisosticta bitriangularis</i> (Say)	
	. . . . . Scymnini <i>Cryptolaemus montrouzieri</i> Mulsant		-	Mandible apically bidentate, with sub-apical tooth, without serrations or comblike structures	30
23(22).	Tergal plates, strumae, with small chazae bearing peglike setae in addition to normal setae (Figs. 107, 108); body densely asperate (Figs. 23, 24), asperities on membrane irregularly truncate (Fig. 109), acute on strumae	24	30(29).	Abdominal terga with strumae, each struma with 2 prominent chazae, anterior chazae smaller than posterior, setae of chazae long (Figs. 41, 118)	31
-	Tergal plates, other structures without chazae, peglike setae; integument with or without asperities Coccinellini	25	-	Abdominal terga otherwise, with parascoli (Figs. 3D, 37, 38, 125), or strumae bearing several prominent chazae (Figs. 3E, 30), or with verrucae (Figs. 3F, 117)	33
24(23).	Abdomen with sharply defined, dorsal light area extending from terga 1-4 through 4 (Fig. 23); strumae sparsely asperate, asperities of strumae short, acute (Fig. 108); habitus Fig. 23		31(30).	Abdominal sterna 3-5 or 4-5 with short, stubby setae in addition to normal setae (Figs. 121, 126)	32
-	. . . . . <i>Rhyzobius lophanthae</i> (Blaisdell)		-	Abdominal sterna without short, stubby setae; habitus Fig. 1	
	. . . . . <i>Rhyzobius forestieri</i> Mulsant		32(31).	Short setae of abdominal sterna 4, 5 sub-apically bulbous (Fig. 121); habitus Fig. 41 <i>Olla v-nigrum</i> (Say)	
25(23).	Abdominal terga 1-8 with senti (Figs. 3G, 34), or with tall bifurcate or trifurcate parascoli (Fig. 122)	26	-	Short setae of abdominal sterna 3-5 terminally truncate or slightly emarginate (Fig. 126); habitus Fig. 45	
-	Abdominal terga 1-8 otherwise, with various structures: parascoli (Figs. 3D, 115, 125), strumae (Figs. 3E, 32, 111), verrucae (Figs. 3F, 11, 117), setae (Figs. 3A, 21), or collar setae (Fig. 3A)	29	33(30).	Tarsungulus simple, without basal tooth or rectangular base (Figs. 130, 131)	34
26(25).	Tergite of 9th abdominal segment with minute, posteriorly directed process on apical margin (Figs. 35, 42)	27	-	Tarsungulus with basal tooth or rectangular base (Fig. 132)	40
-	Tergite of 9th abdominal segment entire, without posterior process	28	34(33).	Abdominal terga 1-8 with short, stout parascoli (Figs. 3D, 32, 33, 115); habitus Figs. 32, 33 <i>Hippodamia</i> Chevrolat	
27(26).	Dorsal senti of abdominal terga short throughout, progressively longer from terga 1-6, shorter on terga 7, 8; habitus Fig. 42 <i>Coelophora inaequalis</i> (F.)		-	Abdominal terga 1-8 either with strumae (Figs. 3E, 30, 113) or verrucae (Figs. 3F, 11, 117)	35
			35(34).	Abdominal terga 1-8 with strumae or 6-8 with parascoli (Figs. 3E, 113)	36
			-	Abdominal terga 1-8 with verrucae, verrucae asperate, with 8 or more setae (Figs. 116, 117); or 6-8 with parascoli	
				. . . . . <i>Myzia</i> Mulsant	
			36(35).	Dorsal strumae of abdominal terga 1-8 each with 4 or less low-based chazae	



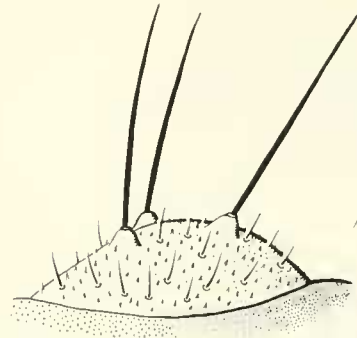
Figs. 93-101. Body structures. Fig. 93, *Hyperaspis psyche*, pronotum; 94, *Hyperaspis postica*, pronotum; 95, *Arawana scapularis*, metanotum; 96, *Axion tripustulatum*, mesonotum and metanotum; 97, *Halmus chalybeus*, pronotum; 98, *Adalia bipunctata*, pronotum; 99, *Cycloneda sanguinea*, pronotum; 100, *Brachiacantha* sp., abdominal terga, showing segmental pores; 101, *Propylea quatuordecimpunctata*, tergite IX.



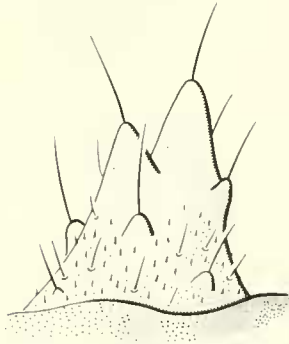
Figs. 102–112. Body structures. Fig. 102, *Cephaloscymnus* sp., intersegmental pore; 103, *Dionus roseicollis*, intersegmental pore; 104, *Cephaloscymnus* sp., lateral struma; 105, *Cryptolaemus montrouzieri*, dorsal verruca, posterior view; 106, *Cryptolaemus montrouzieri*, dorsal verruca, lateral view; 107–109, *Rhyzobius lophanthae*, 107, clublike seta; 108, struma; 109, asperities of membrane; 110, *Azya* sp., chalaza; 111, *Anisosticta* sp., dorsal struma; 112, *Naemia seriata*, struma.



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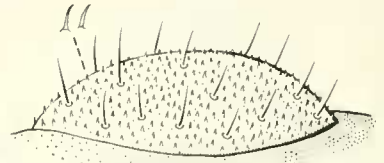
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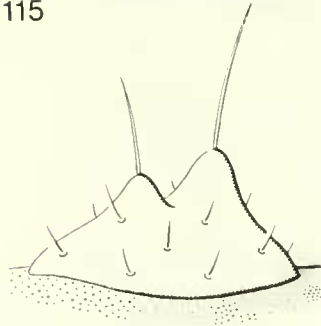
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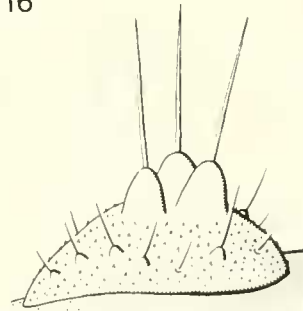
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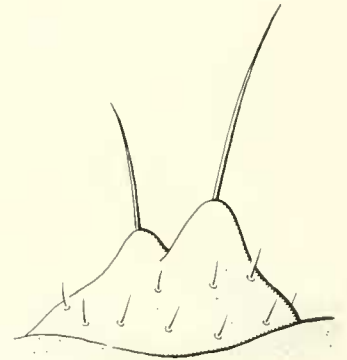
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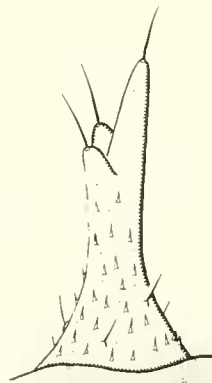
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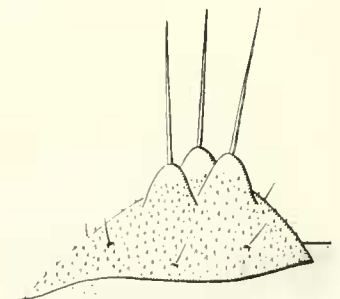
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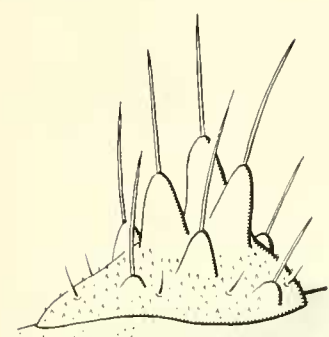


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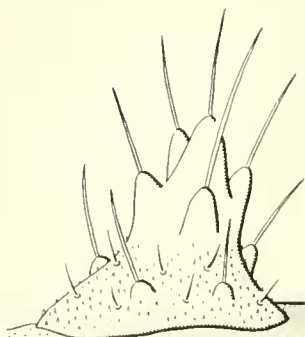


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Figs. 113–123. Body structures. Fig. 113, *Paranaemia vittigera*, dorsolateral struma; 114, *Coleomegilla maculata*, dorsal struma; 115, *Hippodamia convergens*, parascolus; 116, *Myzia pullata*, verruca; 117, *Myzia oblongoguttata*, verruca; 118, *Neoharmonia venusta*, struma; 119, *Adalia bipunctata*, struma; 120, *Olla v-nigrum*, dorsal struma; 121, *Olla v-nigrum*, setae, venter of 4th, 5th abdominal segments; 122, *Harmonia conformis*, trifurcate parascolus; 123, *Cycloneda sanguinea*, struma.



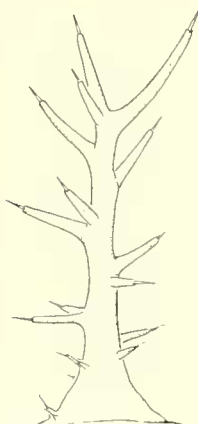
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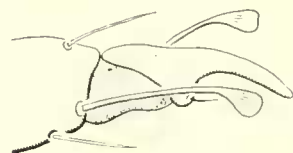
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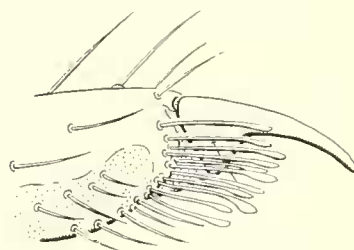
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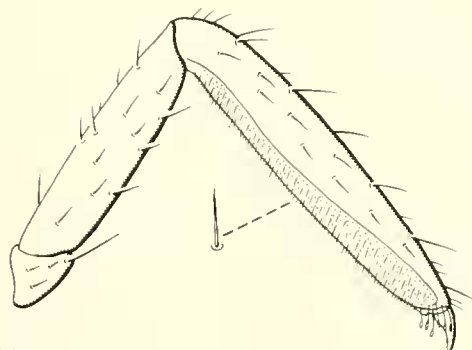
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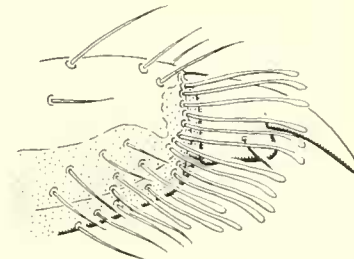
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Figs. 124-132. Body structures. Fig. 124, *Coccinella novemnotata*, struma; 125, *Coccinella septempunctata*, parascolus; 126, *Mulsantina picta*, setae, venter of 4th, 5th abdominal segments; 127, *Epilachna varivestis*, scolus; 128, *Subcoccinella vigintiquatuorpunktata*, scolus; 129, *Hippodamia convergens*, leg; 130, *Delphastus pusillus*, tibiotarsal claw and terminal setae; 131, *Hippodamia convergens*, tibiotarsus; 132, *Coccinella septempunctata*, tibiotarsus.

- on which setae are usually long, black (Figs. 30, 112, 113) 38
- Abdominal terga with more than 4 chalazae on dorsal strumae (Fig. 3E, 44) 37
- 37(36). Abdominal terga 6-8 bearing a dorsal pair of parascoli (Fig. 44); posterior margin of abdominal segment 9 broadly rounded; habitus Fig. 44
 *Aphidecta obliterata* (L.)
- Abdominal terga without parascoli; posterior margin of abdominal segment 9 emarginate medially; habitus Fig. 22
 Coccidulini . . . *Coccidula* Kugelann
- 38(36). Dorsal strumae of abdominal terga 1-8 each bearing 4 chalazae, 2 anteriorly, 2 posteriorly (Fig. 112); dorsolateral strumae with 3 or 4 chalazae 39
- Dorsal strumae of abdominal terga 1-8 each bearing 3 chalazae, 2 anteriorly, 1 posteriorly (Figs. 30, 114); habitus Figs. 30, 31 *Coleomegilla* Timberlake
- 39(38). Dorsolateral strumae of abdominal terga 1-8 bearing 4 chalazae, 2 anteriorly, 2 posteriorly (Fig. 112); habitus Fig. 29 *Naemia serjata* (Melsheimer)
- Dorsolateral strumae of abdominal terga 1-8 bearing 3 chalazae, 1 anteriorly, 2 posteriorly (Fig. 113); habitus Fig. 28 *Paranaemia vittigera* (Mannerheim)
- 40(33). Posterior margin of 9th abdominal segment with short, distinct, apically truncate, median process (Fig. 101); abdominal terga 1-8 with strumae each bearing several chalazae of various sizes; habitus Fig. 40
 *Propylea quatuordecimpunctata* (L.)
- Posterior margin of 9th abdominal tergite entire, without median process; abdominal terga 1-8 with parascoli or strumae 41
- 41(40). Abdominal terga 1-8 with strumae on which only 3 chalazae are prominent, these 3 usually grouped together (Figs. 119, 123) 42
- Abdominal terga 1-8 with either short parascoli or with strumae each bearing several chalazae of various sizes (Figs. 124, 125); habitus Figs. 37, 38
 *Coccinella* L.
- 42(41). Pronotum densely asperate (Figs. 39, 99); tibiotarsus ventrally with setiferous semimembranous surface extending about 1/2 length of segment; habitus Fig. 39
 *Cycloneda* Crotch
- Pronotum without asperities, or if present, asperities few, on posterior margin (Fig. 98); tibiotarsus ventrally with setiferous semimembranous surface extending length of segment, as in *Hippodamia* (Fig. 129); habitus Fig. 36
 *Adalia* Mulsant
- 43(21). Cardines, stipes, submental, mental areas fused into solid, sclerotized, pigmented structure possessing anterior extension on each side, composite structure or area assuming appearance of egg-cup encompassing labial palpi (Fig. 60); maxillary palpus 2-segmented, 1st segment large, 2nd segment small, palpifer distinct, small (Fig. 60) 44
 Novini 44
- Cardines, stipes, submental, mental areas not fused as above into single composite structure, area membranous or nearly so (Figs. 54-57) maxillary palpus variable 45
- 44(43). Antennae 2-segmented, 2nd segment small, short, broad (Fig. 86); habitus Fig. 25 *Rodolia* Mulsant
- Antennae 1-segmented (Fig. 87)
 *Anovia* Casey
- 45(43). Abdominal terga with membranous or non-sclerotized strumae each bearing 2 chalazae with bases extremely small, setae subequal, short, apically truncate (Fig. 110); anterior seta on dorsolateral strumae shorter than posterior seta (Fig. 110); lateral abdominal lobes prominent, acute, with at least 1 seta; habitus Fig. 26 Azyini . . . *Azya* Mulsant
- Abdominal terga otherwise, or if membranous strumae or verrucae with collar setae present, setae distinct, long 46
- 46(45). Ocelli modified, 2 ocelli large, directed anteriorly, usually an elongate internal pigmentation behind each ocellus, 3rd ocellus with distinct lens represented by small dorsal pigmentation may be lacking (Fig. 51); antennae of single short, broad segment (Fig. 82); habitus Fig. 9 Stethorini . . . *Stethorus* Weise
- Ocelli not so modified, normal; antennae 2- or 3-segmented (Figs. 80, 81)
 Scymnini, in part 47
- 47(46). Maxillary palpus 3-segmented, with palpifer, segments of palpus, palpifer distinct, sharply defined (Figs. 54, 55); abdominal terga without intersegmental pores (Figs. 12, 13) 48
- Maxillary palpus 2-segmented, with palpifer (Fig. 56), palpifer, basal segment of palpus weakly sclerotized, often indistinct, poorly defined; abdomen with elliptical intersegmental pores dorsolater-

- ally on each side (Figs. 14, 15, 103); habitus Fig. 14 *Diomus* Mulsant
- 48(47). Antennae 2-segmented (Fig. 81); mental, submental areas of labium fused, semimembranous or weakly sclerotized, rectangular, lateral margins faintly defined (Fig. 55); habitus Fig. 13 *Nephus* Casey
- Antennae 3-segmented, 3rd segment small, sclerotized, distinct (Fig. 80), or very small, weakly sclerotized, indistinct; mental, submental areas more distinct (Fig. 54) or fused 49
- 49(48). Third antennal segment sclerotized, distinct (Fig. 80); tergite of 9th abdominal segment posteriorly rounded (Fig. 12, habitus) *Scymnus* Kugelann
- Third antennal segment weakly sclerotized, indistinct; tergite of 9th abdominal segment with posterior margin truncate to slightly emarginate; abdominal terga 1-8 with strumae each bearing small-based chazae or collar setae, setae long, variously curved; habitus (Fig. 10) *Nephaspis oculata* (Blatchley)

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LITERATURE CITED

Böving, A. G. 1917. A generic synopsis of the coccinellid larvae in the United States National Museum, with a description of the larva of *Hyperaspis binotata* Say. Proceedings of the United States National Museum 51: 621-650.

Emden, F. J. van. 1949. Larvae of British beetles. VII (Coccinellidae). Entomologist's Monthly Magazine 85: 265-283.

Gage, J. H. 1920. The larvae of the Coccinellidae. University of Illinois Biological Monographs 6: 232-294.

Gordon, R. D. 1985. The Coccinellidae (Coleoptera) of America north of Mexico. Journal of the New York Entomological Society 93: 1-912.

Gordon, R. D. and Vandenberg, N. 1991. Field guide to recently introduced species of Coccinellidae (Coleoptera) in North America, with a revised key to North American genera of Coccinellini. Proceedings of the Entomological Society of Washington 93: 845-864.

Kamiya, H. 1965. Comparative morphology of larvae of the Japanese Coccinellidae, with special reference to the tribal phylogeny of the family (Coleoptera). The Memoirs of the Faculty of Liberal Arts, Fukui University. Ser. II, Natural Science 14: 83-100.

———. 1966. On the Coccinellidae attacking scale insects and mites in Japan and the Ryukyus. Mushi 39: 65-93.

Klausnitzer, B. 1970. Zur Larvalsystematik der mitteleuropäischen Coccinellidae (Col.). Entomologische Abhandlungen und berichte aus dem Staatlichen Museum für Tierkunde in Dresden 38: 55-110.

LeSage, L. 1991. Coccinellidae (Cucujoidea), the lady beetles, lady birds. pp. 485-494. In Stehr, F. W., ed., Immature Insects. Vol. 2. Kendall/Hunt. Dubuque, Iowa.

Majerus, M. and Kearns, P. 1989. Ladybirds. Naturalist Handbooks 10. Richmond Publishing Co. Ltd. England. 103 pp.

Phuoc, D. T. and Stehr, F. W. 1974. Morphology and taxonomy of the known pupae of Coccinellidae (Coleoptera) of North America, with a discussion of phylogenetic relationships. Contributions of the American Entomological Institute 10: 1-125.

Sasaji, H. 1968a. Descriptions of the coccinellid larvae of Japan and the Ryukyus (Coleoptera). Memoirs of the Faculty of Education, Fukui University Series II, Natural Science 18: 93-136.

———. 1968b. Phylogeny of the family Coccinellidae (Coleoptera). Etizenia 35: 1-37.

Sasaji, H. and Tjubokawa, K. 1983. Supplementary descriptions of the coccinellid larvae of Japan (Coleoptera). Memoirs of the Faculty of Education,

- Fukui University Ser. II, Natural Science 32: 33-66.
- Savoiskaya, G. I. 1960. [On morphology and taxonomy of ladybird larvae (Coleoptera, Coccinellidae) from south-east Kazakhstan.] *Entomologicheskoe Obozrenie* 39: 122-123. (In Russian with English summary).
- . 1962. [Morphology and taxonomy of the larvae of the genus *Coccinella* L. (Col., Coccinellidae).] *Trudy Institute Zashchite Rastenii, Alma-Ata* 7: 299-315. (In Russian).
- . 1964a. [Materials on morphology and taxonomy of larvae of the tribe Coccinellini (Col., Coccinellidae).] *Trudy Institute Zashchite Rastenii, Alma-Ata* 8: 310-368. (In Russian).
- . 1964b. [On some larvae of the tribe Coelopterini and Hyperaspini, with a description of a new species (Col., Coccinellidae).] *Trudy Institute Zashchite Rastenii, Alma-Ata* 8: 358-370. (In Russian).
- . 1983. [Larval coccinellid fauna of USSR.] Leningrad. Nauka, Leningrad Branch. 242 pp. (In Russian).
- Savoiskaya, G. I. and Klausnitzer, B. 1973. Key to the subfamilies, tribes, genera and species of some larvae of the Palearctic Coccinellidae, pp. 39-55. *In* Hodek, I., ed., *Biology of Coccinellidae*. Dr. W. Junk, The Hague.
- Storch, R. H. 1970. Field recognition of the larvae of native Coccinellidae common to the potato fields of Aroostook county. *Maine Agricultural Experiment Station Technical Bulletin* 43: 1-16.
- Tao, C. C. and Chiu, S. C. 1971. Biological control of citrus, vegetables and tobacco aphids. *Taiwan Agricultural Research Institute, Taiwan. Special Publication* 10: 1-110.